

WHAT IS CLAIMED IS:

- 1 1. An optical fiber for producing laser radiation at a characteristic wavelength, the optical
2 fiber comprising:
3 a first multimode core region having a first index of refraction, the core region being
4 adapted for guiding the laser radiation in a longitudinal direction of the fiber and adapted
5 for guiding pump radiation; and
6 an active region embedded within the core region for producing radiation at the
7 characteristic wavelength when pumped by pump radiation, the active region having a
8 sufficiently small transverse dimension such that radiation produced in the active region
9 is not confined to the active region.
- 1 2. The optical fiber of claim 1, wherein less than about 50% of the radiation produced at the
2 characteristic wavelength in the active region is confined in the active region.
- 1 3. The optical fiber of claim 1, wherein less than about 10% of the radiation produced at the
2 characteristic wavelength in the active region is confined in the active region.
- 1 4. The optical fiber of claim 1, wherein less than about 5% of the radiation produced at the
2 characteristic wavelength in the active region is confined in the active region.
- 1 5. The optical fiber of claim 1, wherein less than about 2% of the radiation produced at the
2 characteristic wavelength in the active region is confined in the active region.
- 1 6. The optical fiber of claim 1, wherein the transverse dimension of the active region is
2 smaller than the characteristic wavelength.
- 1 7. The optical fiber of claim 1, wherein the active region has a second index of refraction
2 different from the first index of refraction, and the combination of the transverse
3 dimension of the active region and the difference between the first index of refraction and
4 the second index of refraction are such that the radiation produced in the active region is
5 not confined to the active region.

- 1 8. The optical fiber of claim 1, wherein the desired mode is the lowest order mode of the
2 optical fiber.
- 1 9. The optical fiber of claim 1, wherein the desired mode is a Gaussian mode of the optical
2 fiber.
- 1 10. The optical fiber of claim 1, wherein the optical fiber has a gain along its longitudinal
2 direction that is sufficiently small, so that a desired laser mode operates above a lasing
3 threshold while all other modes operate below the lasing threshold.
- 1 11. The optical fiber of claim 1, further comprising a mode discriminator for discriminating
2 against undesired modes of light generated in the multimode fiber while allowing a
3 desired mode of light to propagate in the multimode fiber.
- 1 12. The optical fiber of claim 11, wherein the mode discriminator is a free space propagation
2 path defined between a mirror and the first multimode fiber.
- 1 13. The optical fiber of claim 12, further comprising an optical element located in the free
2 space propagation path, and
3 wherein the optical element is adapted to transmit light emitted from the first
4 multimode fiber in a desired mode and retroreflected by the mirror back into the
5 multimode fiber and is adapted not to transmit light emitted from the first multimode
6 fiber in undesired modes back into the first multimode fiber.
- 1 14. The optical fiber of claim 13, wherein the optical element is a mirror.
- 1 15. The optical fiber of claim 11, further comprising:
2 a second multimode optical fiber for guiding the laser radiation, and
3 wherein the mode discriminator is a free space propagation path between the first
4 multimode fiber and the second multimode fiber.

1 16. The optical fiber of claim 15, further comprising:

2 an optical element located in the free space propagation path, and

3 wherein the optical element is adapted to transmit light emitted from the first

4 multimode fiber in a desired mode into the second multimode optical fiber.

1 17. The optical fiber of claim 16, wherein the optical element is a lens.

1 18. The optical fiber of claim 11, wherein the mode discriminator is a fiber grating.

1 19. The optical fiber of claim 11, further comprising:

2 a second multimode optical fiber for guiding the laser radiation, and

3 wherein the mode discriminator is a third multimode fiber located between the first

4 multimode fiber and the second multimode fiber.

1 20. The optical fiber of claim 19, wherein the third multimode fiber has an index of refraction

2 that varies in the radial direction of the fiber.

1 21. The optical fiber of claim 11, wherein the mode discriminator is a tightly bent section of

2 the optical fiber.

1 22. The optical fiber of claim 21, wherein the tightly bent section of the optical fiber is bent

2 substantially in the shape of a kidney.

1 23. The optical fiber of claim 11, wherein the mode discriminator is multiple tightly bent

2 sections of the optical fiber, the bent sections laying substantially in non-parallel planes.

1 24. The optical fiber of claim 23, wherein at least one tightly bent fiber section of the optical

2 fiber is bent substantially in the shape of a kidney.

1 25. The optical fiber of claim 1, further comprising a mode discriminator means for

2 discriminating against undesired modes of light generated in the multimode fiber while

3 allowing a desired mode of light to propagate in the multimode fiber.

- 1 26. The optical fiber of claim 25, wherein the transverse dimension of the active region is
2 smaller than the characteristic wavelength.
- 1 27. The optical fiber of claim 25, wherein the desired mode is the lowest order mode.
- 1 28. The optical fiber of claim 25, wherein the desired mode is a Gaussian mode.
- 1 29. The optical fiber of claim 25, wherein the optical fiber has a gain along its longitudinal
2 direction that is sufficiently small so that a desired laser mode operates above a lasing
3 threshold while all other modes operate below the lasing threshold.
- 1 30. A method of providing laser energy with a characteristic wavelength in a single optical
2 mode to a surface, the method comprising:
3 pumping an active region embedded in a multimode optical fiber with pump energy
4 to produce the laser energy with the characteristic wavelength, wherein the active region
5 has a transverse dimension smaller than the characteristic wavelength; and
6 guiding the generated light to the surface with the multimode fiber.